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# ***Rapid / Expedited Systems Engineering***

**Presented To:  
3<sup>rd</sup> Annual SERC Research Review**

**6 Oct 2011**



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Distribution Statement A – Cleared for public release by 88th  
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3<sup>rd</sup> Annual SERC Research Conf. 5-6 Oct 2011

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>06 OCT 2011</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2011 to 00-00-2011</b>	
4. TITLE AND SUBTITLE <b>Rapid / Expedited Systems Engineering</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Air Force Institute of Technology, Air Force Center for Systems Engineering, 2950 Hobson Way, Wright Patterson AFB, OH, 45433</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>16</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# **Successful SE** **Layered Integrated Framework**



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**Oversight & Control Activities**  
(Governance: Policy, Councils, Oversight Boards, etc)

**Collaborative Environments & Hierarchical Organizations**  
(Where SE's Work)

**Standard Systems Engineering Processes**  
(Tailored to Meet Organizational Needs)

**Common Methods, Models & Tools**  
(Future Will Demand Greater Interoperability)

**Common Language**  
(Obtained Through; Education, Training & Experience)

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# Overarching Conceptual Construct



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## Systems



## Design Environments



## Capabilities



## Effects



Developed w/  
in  
Environments

Enabling  
Capabilities

Deliver an  
Effect

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# Overarching Conceptual Construct Where SE's Primarily Reside



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## Systems



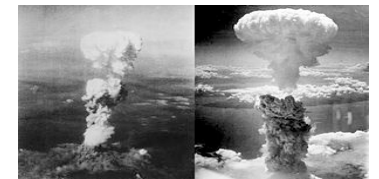
## Design Environments



## Capabilities



## Effects



Developed w/  
in  
Environments

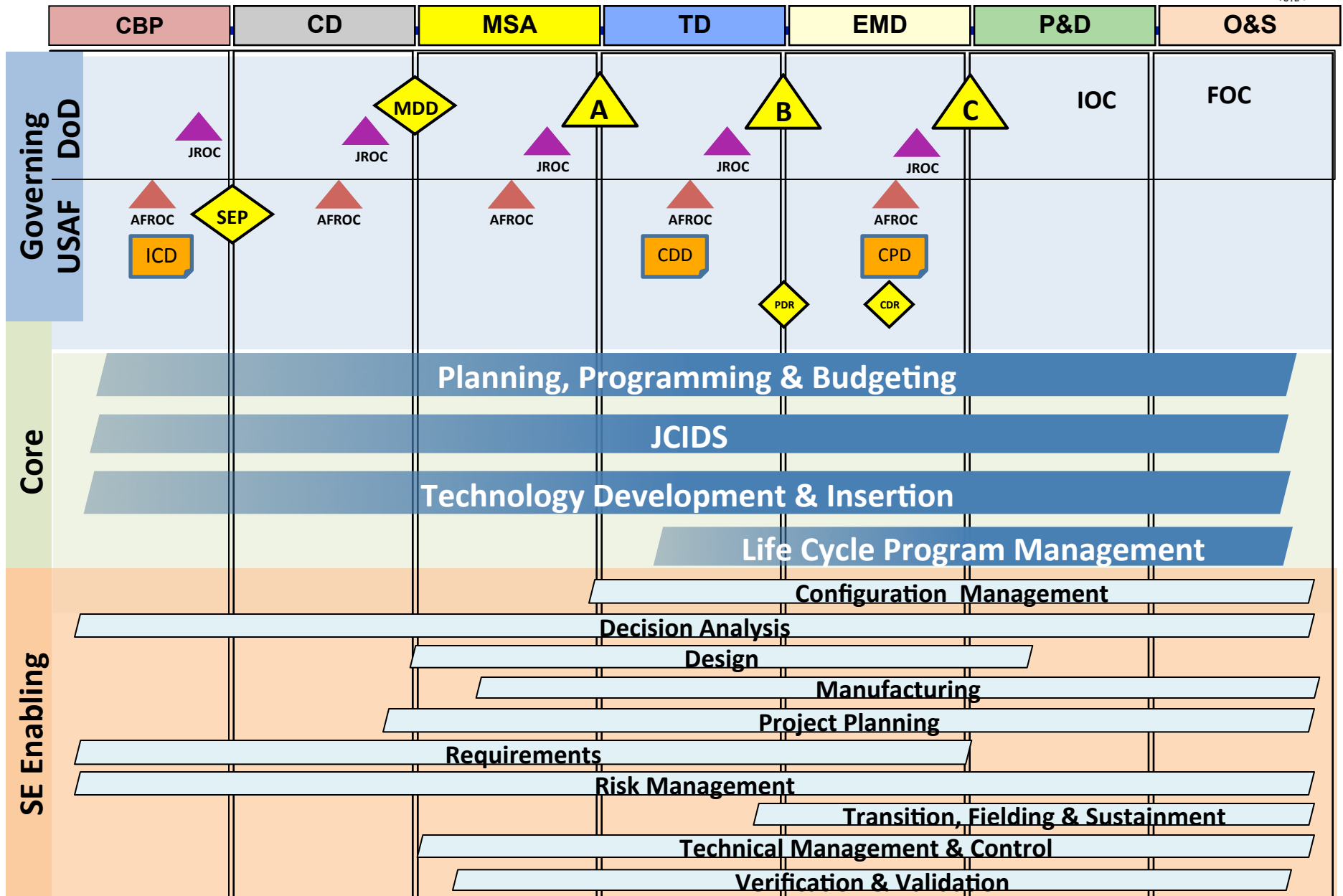
Enabling  
Capabilities

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# Systems Engineering Processes In Context

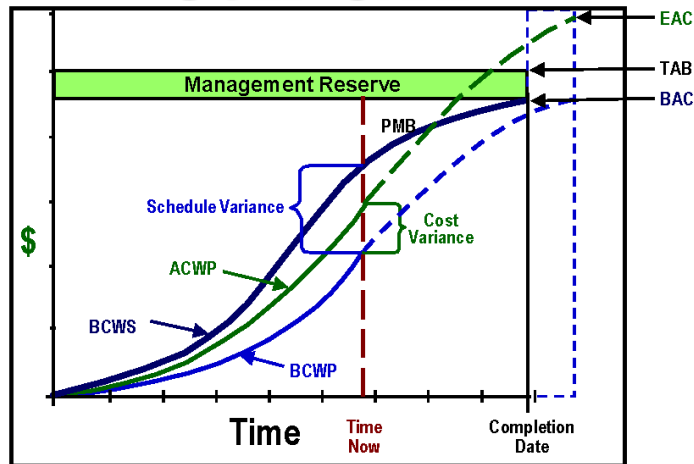






# EARNED VALUE MANAGEMENT

## 'GOLD CARD'



**VARIANCES** Favorable is Positive, Unfavorable is Negative

$$\text{Cost Variance } CV = BCWP - ACWP \quad CV\% = (CV / BCWP) \times 100$$

$$\text{Schedule Variance } SV = BCWP - BCWS \quad SV\% = (SV / BCWS) \times 100$$

$$\text{Variance at Completion } VAC = BAC - EAC$$

### OVERALL STATUS

$$\% \text{ Schedule} = (BCWS_{CUM} / BAC) \times 100$$

$$\% \text{ Complete} = (BCWP_{CUM} / BAC) \times 100$$

$$\% \text{ Spent} = (ACWP_{CUM} / BAC) \times 100$$

### TW DoD TRIPWIRE METRICS

$$\text{Cost Efficiency } CPI = BCWP / ACWP \quad \text{Favorable is } > 1.0, \text{ Unfavorable is } < 1.0$$

$$\text{Schedule Efficiency } SPI = BCWP / BCWS \quad \text{Favorable is } > 1.0, \text{ Unfavorable is } < 1.0$$

### TW BASELINE EXECUTION INDEX (BEI) = A Schedule Metric

$$BEI = \text{Tasks with Actual Finish Date} / (\# \text{ of Baseline Tasks Scheduled to Finish Prior to Status Date} + \text{Tasks Missing Baseline Start or Finish Date})$$

### TW CRITICAL PATH LENGTH INDEX (CPLI) = A Schedule Metric

$$CPLI = (CP \text{ Length}_{(\text{Time Now To Contract End})} + \text{Total Float}_{(\text{To Contract End Baseline Finish})}) / CP \text{ Length}$$

$$\text{Hit / Miss} = \text{Month's Tasks Completed ON or AHEAD} / \text{Month's Tasks Scheduled to Complete}$$

$$\# \text{ ESTIMATE @ COMPLETION (EAC)} = \text{Actuals to Date} + [(\text{Remaining Work}) / (\text{Performance Factor})]$$

$$EAC_{CPI} = ACWP_{CUM} + [(BAC - BCWP_{CUM}) / CPI_{CUM}]$$

$$= BAC / CPI_{CUM}$$

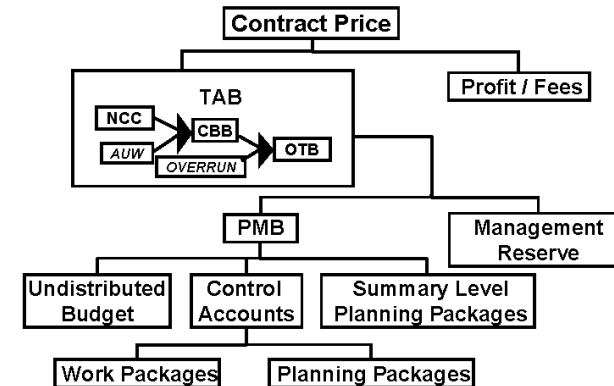
$$EAC_{\text{Composite}} = ACWP_{CUM} + [(BAC - BCWP_{CUM}) / (CPI_{CUM} \times SPI_{CUM})]$$

### # \$ TO COMPLETE PERFORMANCE INDEX (TCPI)

$$TCPI_{EAC} = \text{Work Remaining} / \text{Cost Remaining} = (BAC - BCWP_{CUM}) / (EAC - ACWP_{CUM})$$

# To Determine a Contract Level TCPI or EAC; You May Replace BAC with TAB

\$ To Determine the TCPI <sub>BAC or LRE</sub> Substitute BAC or LRE for EAC



### ACRONYMS

ACWP	Actual Cost of Work Performed	Cost actually incurred in accomplishing work performed	= ACTUAL COST
AUW	Authorized Unpriced Work	Work contractually approved, but not yet negotiated / definitized	
BAC	Budget At Completion	Total budget for total contract thru any given level	
BCWP	Budgeted Cost for Work Performed	Value of completed work in terms of the work's assigned budget	= EARNED VALUE
BCWS	Budgeted Cost for Work Scheduled	Time-phased Budget Plan for work currently scheduled	= PLANNED VALUE
CA	Control Account	Lowest CWBS element assigned to a single focal point to plan & control scope / schedule / budget	
CBB	Contract Budget Base	Sum of NCC & AUW	
EAC	Estimate At Completion	Estimate of total Cost for total contract thru any given level may be generated by Ktr, PMO, DCMA, etc. = $EAC_{Ktr / PMO / DCMA}$	
LRE	Latest Revised Estimate	Ktr's EAC or $EAC_{Ktr}$	
MR	Management Reserve	Budget withheld by Ktr PM for unknowns / risk management	
NCC	Negotiated Contract Cost	Contract Price Minus profit or fee(s)	
OTB	Over Target Baseline	Sum of CBB & recognized overrun	
PAC	Price At Completion	NCC Plus Profit or Fee(s)	
PMB	Performance Measurement Baseline	Contract time-phased budget plan	
PP	Planning Package	Far-term CA activities not yet defined into WPs	
SLPP	Summary Level Planning Package	Far-term activities not yet defined into CAs	
TAB	Total Allocated Budget	Sum of all budgets for work on contract = NCC, CBB, or OTB	
TCPI	To Complete Performance Index	Efficiency needed from 'time now' to achieve a BAC, EAC, or LRE	
UB	Undistributed Budget	Broadly defined activities not yet distributed to CAs	
WP	Work Package	Near-term, detail-planned activities within a CA	

**EVM POLICY:** DoDI 5000.02, Encl 4. Table 5. EVMS in accordance with ANSI/EIA-748 is required for cost or incentive contracts, subcontracts, intra-government work agreements, & other agreements valued  $\geq \$20M$  (Then-Yr \$). EVMS contracts  $\geq \$50M$  (TY \$) require that the EVM system be formally validated by the cognizant contracting officer. Additional Guidance in Defense Acquisition Guidebook & Earned Value Management Implementation Guide (EVMIG). EVMS is discouraged on Firm-Fixed Price & Time & Material Contracts; & LOE activities regardless of cost.

### EVM CONTRACTING REQUIREMENTS:

FAR EVM Clauses	<b>NOT For DoD</b>	- 52.234-2 for Solicitation = Pre-Award IBR or - 52.234-3 = Post Award IBR
		- 52.234-4 for Solicitation & Contract
DoD Use	DFAR CLAUSES $\geq \$20M$	- 252.234-7001 "NOTICE OF EVMS" FOR SOLICITATIONS
		- 252.234-7002 "EVMS" FOR SOLICITATIONS & CONTRACTS
CONTRACT PERFORMANCE REPORT		- DI-MGMT-81466A* 5 FORMATS = WBS, ORGANIZATION, BASELINE, STAFFING, EXPLANATION
INTEGRATED MASTER SCHEDULE		- DI-MGMT-81650* MANDATORY FOR DoD EVMS CONTRACTS
INTEGRATED BASELINE REVIEW		- MANDATORY FOR ALL EVMS CONTRACTS

\* Refer to the EVMIG for CPR & IMS tailoring guidance

EVM Home Page = <https://acc.dau.mil/evm>  
eMail Address: [EVM.dau@dau.mil](mailto:EVM.dau@dau.mil)  
Revised November 2010



## ***Doing The Same - Differently***

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### **SAMPLE REPORTING FORMAT**

**PERIOD ENDING (DATE)**

<b>TASK DESCRIPTION</b>	<b>SCHEDULED START DATE</b>	<b>ACTUAL START DATE</b>	<b>SCHEDULED COMPLETE DATE</b>	<b>ACTUAL COMPLETE DATE</b>	<b>BUDGETED AMOUNT (\$)</b>	<b>ACTUAL AMOUNT EXPENDED TO DATE (\$)</b>	<b>ESTIMATED PERCENT COMPLETE</b>	<b>PERCENT EXPENDED TO DATE (BUDGET/ACTUAL) (\$)</b>

**Shifting The Curve**





# What's Needed



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## *Collaborative Design and Decision Support:*

Tools, methods, processes and environments that allow engineers, warfighters, and other stakeholders to share and discuss choices. This spans human-system interaction, collaboration technology, visualization, virtual environments, and decision support.

**Creating The Technical Workplace of Tomorrow**

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# Breaking It Down



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- The capability when employed— will serve as the critical integrating component in attainment of systems by bringing together all of the stakeholders (engineers, warfighters, logisticians, etc.) across all of the processes (conception, design, engineering, prototyping, production and field use and adaption).
- At a minimum the environment will link:
  - Engineering models/tools
  - Virtual demonstration space (e.g. war gaming, synthetic environments, virtual environments)
  - Deployed systems (live and physical test environments)
  - Situational factors (e.g. funding constraints, presently available resources, physical environment, threats, political situation, adversarial military and technological capabilities, etc)



# Breaking It Down (con' t)



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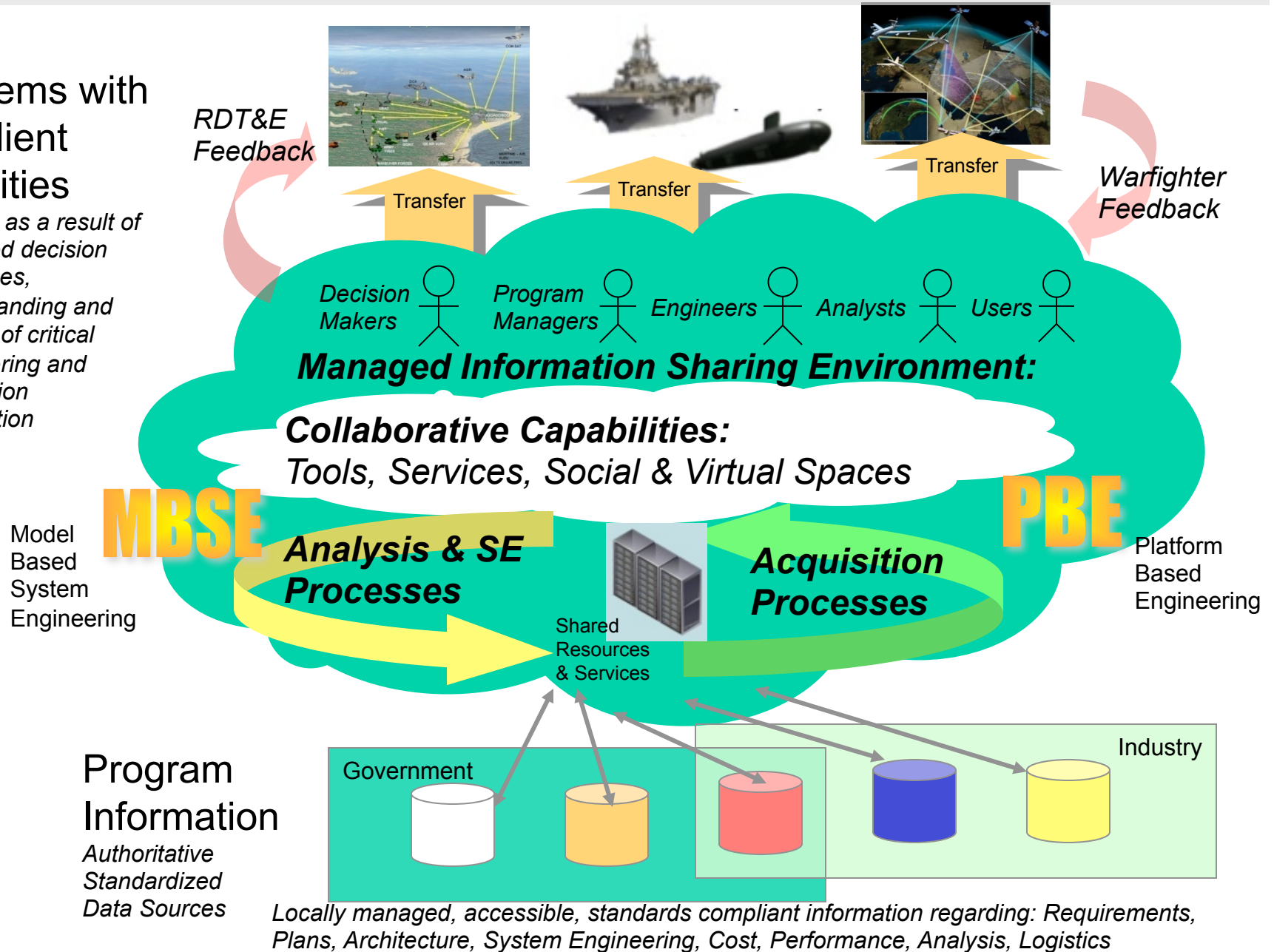
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- The purpose of the environment is to:
  - Support a closer to "real-time" Executive Information System (EIS)
  - Enabled by Analysis of Alternatives (AoA) models which together;
  - Drive a Decision Support Systems (DSS)
- The environment must support both development of new systems and stimulate adaption of existing systems
- The goal will be to assist decision makers in decisions regarding:
  - How to best achieve established requirements
  - Examination and setting of requirements based on combined "knee of the curve" determinations
  - "Mission utility breadth assessments"
  - Alternative product and system of systems configurations
  - Divisions of solution between system solution and ConOps

# Potential Virtual Collaborative Environment (VCE) OV-1

## Systems with Resilient Qualities

*Derived as a result of improved decision processes, understanding and sharing of critical engineering and acquisition information*





# Potential Research Needs



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## 1. Dissemination:

- Robust, trusted, standardized information exchange policy enforcement services

## 2. Process - Business:

- Definition of business intelligence services that address enterprise scale large data analytics and visualization of system engineering data

## 3. Infrastructure - Synthetic Environments for Professional and Social Interactions:

- Social services that inform and integrate the acquisition community



# Potential Research Needs (con't)



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## 4. People:

- Training & retraining techniques and curriculum to accelerate workforce MBSE skills acquisition and maintenance

## 5. Security & Information Assurance:

- Policies and supporting tools and methods to ensure cyber security in a relaxed RDT&E CVE IA environment





# Potential Research Needs (con't)



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## 6. MBSE:

- Automated techniques that can assess modeling patterns and products
- Tools and techniques to reverse engineer and assess legacy systems software to generate modernized less vulnerable code.
- Tools and techniques to simplify and accelerate the transformation of system engineering models into simulated virtual entities for analysis and training



# The Challenge



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Create the nations technical workplace of  
tomorrow by shifting the curve

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